Chem2110 Quiz 2
19 October, 2011

TIME: 1 Hour

NAME: MODEL ANSWERS **ID NUMBER:** MSS/FL/2011

1 H 1.008																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226	89 Ac† (227)															

Question	Maximum Marks	Score
1	50	
2	35	
Total	85	

QUESTION 1

(11)

(a) Write the **name** of each of the following substances:

BrF	bromine monofluoride
Bi^{3+}	bismuth(III) ion
HCN(*aq*)	hydrocyanic acid
CsO_2	cesium superoxide
$Au(NO_2)_3$	gold(III) nitrite
$H_3PO_3(aq)$	phosphorous acid
P_4O_{10}	tetraphosphorus decoxide
$Pt(IO)_2$	platinum(II) hypoiodite
$Sn(SCN)_4$	tin(IV) thiocyanate
Cu_2Te	copper(I) telluride
$NaHCO_3$	sodium hydrogen carbonate (bicarbonate

(11)

(b) Give a chemical formula for each of the following substances:

Aluminium bromate	$Al(BrO_3)_3$
Water vapour	$H_2O(g)$
Cadmium formate	$(HCOO)_2Cd$
Ammonium permanganate	NH_4MnO_4
Potassium hydrogen phosphate	K_2HPO_4
Calcium hydride	CaH_2
Xenon tetrachloride gas	$XeCl_4(g)$
Iron(III) hydrogen sulfite	$Fe(HSO_3)_3$
Hydroiodic acid	$HI(aq)$
Zinc nitrate	$Zn(NO_3)_2$
Chromium(III) chromate	$Cr_2(CrO_4)_3$

(c) Complete the following statements: (28)

(i) $(NH_4)_2SO_4$ is described as ionic whereas NH_3 is described as molecular or covalent

(ii) Sr is the symbol of strontium whereas SrSe is the chemical formula of strontium selenide.

(iii) Na is a neutral atom whereas Na^+ is a positively charged atom.

(iv) One of the atoms of the element magnesium contains 13 neutrons and 12 protons in the nucleus. Therefore, the symbol of this element is $^{25}_{12}Mg$.

(v) $CoSO_4 \cdot 7H_2O$ is hydrated whereas $CoSO_4$ is anhydrous; the name of $CoSO_4 \cdot 7H_2O$ is cobalt(II) sulfate heptahydrate

(vi) Metalloids are also known as semimetals

(vii) An atomic orbital is represented by the symbol ψ_{n,ℓ,m_ℓ} from the Schrödinger equation in quantum mechanics.

(viii) Atomic orbitals in any subshell are degenerate. Therefore, the maximum number of unpaired electrons in any subshell is $2\ell+1$ according to Hund's rule.

(ix) The nonmetals with ~~two unpaired~~ four electrons in the *p* subshell are **collectively** known as the chalcogens

(x) ^1H, ^2H and ^3H are isotopes of hydrogen

(xi) The Pauli exclusion principle states that it is not possible for any two electrons in a given atom to have the same set of four quantum numbers.

(xii) According to the Aufbau principle, atomic orbitals are filled with electrons from the lowest to the highest energy levels, starting with the *s* subshell.

(xiii) The Heisenberg uncertainty principle is stated mathematically as follows:

$\Delta x \cdot \Delta(mv) \geq h/4\pi$

$\Delta(mv)$ stands for the uncertainty in the momentum of the moving particle

QUESTION 2

(4) **(a)** Which of the following **orbital designations** or **quantum numbers** are allowed? (✓ or ✗)

$3f$ ✗ $2d$ ✗

$n = 4, \ell = 2, m_\ell = 3, m_s = +½$ ✗

$n = 3, \ell = -2$ ✗

(6) **(b)** What is the maximum number of **atomic orbitals** or **electrons** in an atom that can have the following quantum numbers? **(2 marks)**

$n = 6, m_\ell = 1$ 5 unpaired electrons

$n = 3, \ell = 1, m_s = +½$ 3 electrons

$n = 6, \ell = 3, m_\ell = 3$ 1 atomic orbitals

(4) **(c)** Two transition elements in Period 4 have atoms with **two unpaired electrons** in the ground state.

Give the names of these two transition elements: titanium, nickel

(3) **(d)** A certain element in Period 4 has the **largest number of unpaired electrons** in the ground state. One atom of this element has 26 neutrons.

Give the **atomic symbol** of this element. $^{50}_{24}Cr$

(4) **(c)** An unknown element, **X**, is in Group 5A.

(i) This element has five valence electrons. 1

(ii) Give the **chemical formula** of the **compound** which an **ion** of **X** forms with the **mercury(I)** ion.

Hg_2^{2+}, X^{3-} $(Hg_2)_3X_2$ 3

(4) **(d)** A certain atom has the electron configuration $[Kr]5s^14d^{10}$. ⇒ atomic number = 47

(i) Is this atom in the **ground state** or **excited state**? ground state 1

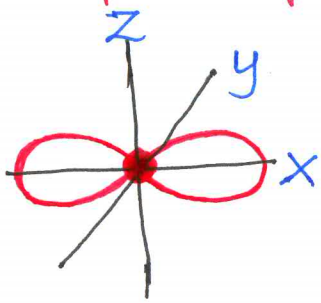
(ii) Give the **chemical formula** of the **compound** which the **ion of this element** forms with the **dichromate ion**.

Ag^+, $Cr_2O_7^{2-}$ $Ag_2Cr_2O_7$ 3

(10) **(e)** Assume that the **last electron** in an atom of **aluminium** occupies the p_x **orbital** in the ground state.

(i) **Draw** and **describe** this p_x **orbital** which contains the unpaired electron.

$_{13}Al \quad 1s^2 2s^2 2p^6 3s^2 3p^1 \Rightarrow 3p_x^1$ (1)



(2)

The $3p_x$ orbital has two lobes that lie directly on the x-axis. There is a nucleus at the centre. This atomic orbital has one radial (or spherical) node ($n-l-1 = 3-1-1 = 1$). This orbital is in the third shell ($n=3$). (5)

(ii) Give the **set of quantum numbers** for the last electron in the atom of **aluminium**.

$3p_x^1 \Rightarrow n=3,\ l=1,\ m_l=1,\ m_s=+\frac{1}{2}$

(2)